

2.0 CONFIGURATION MANAGEMENT BASELINE

This CM baseline describes the current version status, development history, available documentation, and configuration management policies, procedures, guidelines, and support function in place for the SWEG. Configuration management policies are set forth in the SWEG Management Plan [3]. That plan is still in the process of being finalized and implemented. The current baseline version of SWEG is version 6.5.5.

2.1 MODEL DESCRIPTION

SWEG is a general purpose conflict simulation, designed for use in a wide variety of applications. The model is most commonly used for mission- or raid-level analysis. SWEG simulates the interactions between any number of entities (players). Player functions are simulated using generic functions representing sensing, talking, shooting, jamming, moving, and thinking. Since the functional processes are generic, specific platforms and weapon systems, as well as their relationships, how they communicate, and how they react to the changing battle environment, are described in a set of user-configured databases, using the SWEG Conflict Language (SCL).

SWEG players can be configured at various levels of detail, and players' perceptions and tactics are a significant element of SWEG. Each player's current perception of his conflict problem affects the set of tactical actions chosen from among his available tactical options, which in turn affects other players' perceptions. Command chains and communications networks can be defined, so that perceptions can be shared and players can be controlled and coordinated by other players.

SWEG makes use of several databases for model execution. The Type Database (TDB) holds player configurations, performance data, and tactics, for each type of entity. The Scenario Database (SDB) identifies which player types actually exist in the current simulation environment, their initial locations, command structures and initial plans. The Model Instructions or Runtime Database (RDB) contains instructions for starting and stopping the simulation, what types of data to capture, and what display options to use. The Ground and Environmental Databases (GDB, EDB) are used in processing Defense Mapping Agency (DMA) digital terrain elevation data (DTED). The Analysis Database (ADB) contains instructions for data retrieval, the Configuration Database (CDB) contains instructions to link external assets to SWEG, and the Icon Database (IDB) contains graphics icons. Figure 2-1 illustrates the relationships between the various elements of SWEG.

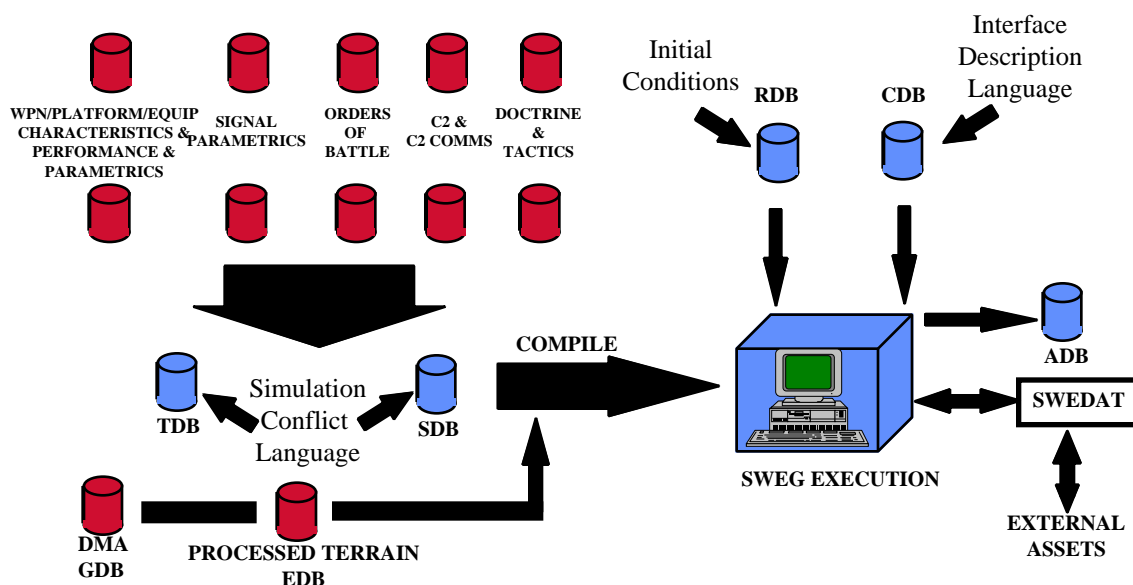


FIGURE 2-1. SWEG Data Flow.

An important feature of SWEG is its ability to interface with other assets, through the SWEG Data Interface System (SWEDAT), so that a SWEG exercise can also include players represented by other simulations, as well as simulators, hardware (live assets), C4I (Command, Control, Communication, Computer and Intelligence) systems, and humans. The SWEG interface is compliant with both DIS (Distributed Interactive Simulation) and HLA (High-Level Architecture) protocols.

SWEG is owned and controlled by the Air Combat Environment Test and Evaluation Facility (ACETEF) at The Naval Air Warfare Center - Aircraft Division (NAWC-AD), located at Patuxent River, MD. SWEG is a vital part of the activities of ACETEF. The model has also supported distributed or virtual simulation within the Joint Theater Missile Defense Program (JTMD) Joint Test Force (JTF). SWEG has recently been selected by the Joint Strike Fighter (JSF) Program to support requirements definition in both constructive and virtual simulation environments. Additional descriptive information is listed in Table 2-1.

TABLE 2-1. SWEG Description.

Title	Description
Model Owner	Naval Air Development Center Aircraft Division, Air Combat Environment Test and Evaluation Facility (ACETEF), Patuxent River, MD.
Point of Contact	Mr. William Zimmerman, Model Manager, Voice: (301) 342-6839; FAX: (301) 342-6381.
Model Developer	ACETEF
Authors	Principal author is Mr. Peter Lattimore, Bosque Technologies, Inc., Albuquerque, NM, (505) 880-8824.
Purpose	General-purpose combat simulation.

TABLE 2-1. SWEG Description. (Contd.)

Title	Description
Domain	Air, ground, naval, space operations.
Scope of Conflict	Varies: one-on-one to thousands of vehicles or other entities.
Level of Detail	User can define the level of detail for players to some degree; most commonly used for mission level analysis.
Human participation	Possible, but not required. Interfacing with man-in-the-loop simulations can be implemented using networking capabilities.
Time processing	Event-stepped.
Host Platforms (Operating Systems)	Development platform is Silicon Graphics Indigo (IRIX 5.3, 6.2). Although other platforms have hosted SWEG in the past, SGI is the only platform currently supported by ACETEF.
Compilers	SGI-supplied C++ compilers.
Language	C++.
Security Classification	Source code and documentation UNCLASSIFIED.
Distributed by	ACETEF

2.2 DEVELOPMENT HISTORY

The current version of SWEG is the result of approximately 20 years of software development, studies and analyses, data base development, testing and practical applications. Figure 2-2 illustrates the history of SWEG and other simulations that form part of its heritage.

The CASM (Combined Arms Simulation Model) Preliminary Design described a multi-level of detail, multi-application simulation. CASM attempted to consider multiple computer processors, dynamic changes in the level of detail, and realistic representation of thought processes and maneuvers. Ideas from this design were used to build TCOR I (Theater/Corps).

TCOR I allowed for two dimensional movement of ground units, at a division level of detail, with user-supplied operations orders for the top level units on either side. Movement of units occurred along axes connecting adjacent hexagons. This was an improvement over most ground combat simulations of the time, in which movement was portrayed as a one-dimensional movement of the front lines of opposing forces. TCOR I was not used for any studies: rather, it was a proof of principle that ideas from CASM could be implemented.

CLEW (Corps Level Electronic Warfare) was created from TCOR I for the Director, Defense Research and Engineering (DDR&E) and others. It added detail in the representation of sensors, communication, and jammers. CLEW evolved into CLEW I and CLEW II, and these models were used for analyses of Army helicopter sensors, electronic support measures (ESM), and electronic warfare (EW) systems, and for communications analyses.

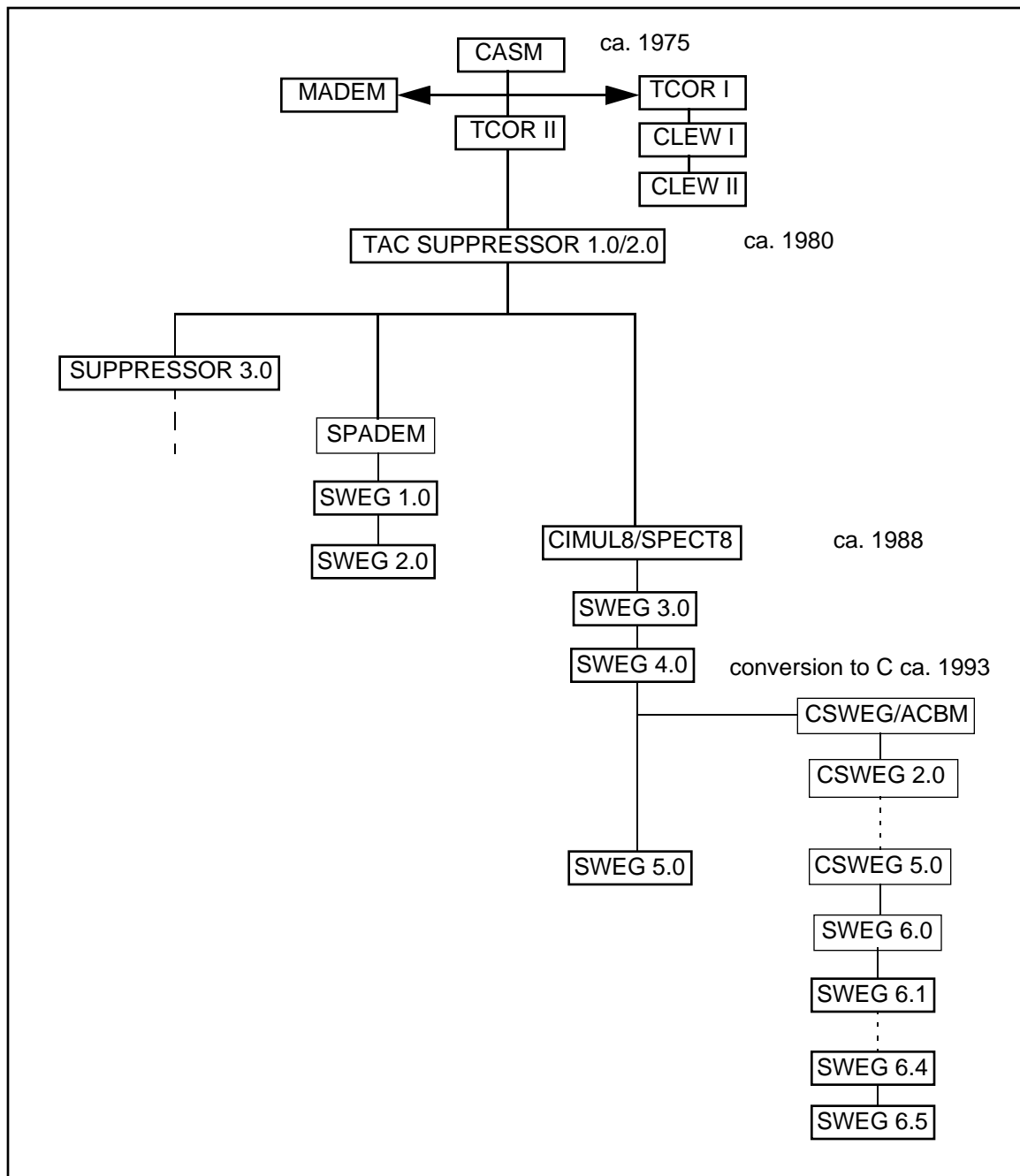


FIGURE 2-2. SWEG Model History Diagram.

MADEM (Modular Air Defense Effectiveness Model) represented RED attacks against a BLUE air defense. It was designed to simulate scenarios of several days duration (in operational time). The user defined plans for the RED attack, including target priorities, formation requirements, raid and wave requirements, corridors and buffer zones, target types, etc. The BLUE side had an integrated air defense with army and air force units. MADEM was used for studies, mostly for Defense Nuclear Agency, up until the mid to late 80's. MADEM showed there were problems with controlling unit paths using hexagons or

other restricted shapes, when the methods were extended to the faster-moving platforms employed in air attack operations.

TCOR II started from scratch, using lessons learned from MADEM and TCOR I. TCOR II used two simultaneous levels of detail for force representation--company and division units. Campaign plans for each side were user-defined. TCOR II solved some of the movement problems, but the hexagons caused problems with representation of terrain features. Completely free play movement was still felt to be too difficult to implement in a computer simulation.

TAC SUPPRESSOR 1.0/2.0 was released in 1980 based on the ideas that grew from CASM, TCOR I and II, and MPACT II. Suppressor continued to be developed under Air Force sponsorship. SPADEM (Space Defense Analysis Model) was developed at BDM, and featured dynamic disaggregation of entities (namely re-entry vehicles). It also added a 3D flyout option for implicitly represented weapons, a number of new tactical criteria, and a redevelopment of the assignment logic into the present-day resource allocation logic.

The first SWEG versions evolved at BDM from SPADEM, with the objective of supporting hardware-in-the-loop (HWIL) and other network applications. SWEG 1.0 came into being in 1987, when work to integrate a chaff and flare simulator with the model was performed for the Naval Weapons Center (now Naval Air Warfare Center - Weapons Division (NAWC-WD)) at China Lake, CA. SWEG 2.0 was a proof of concept for chaff and flare integration which was performed for a human factors group at NAWC-AD at Patuxent River, MD. SWEG 3.0 marked the beginning in earnest of the development, under ACETEF sponsorship, of a more complete capability to incorporate remote assets, by integrating a manned F/A-18 flight simulator and the Enhanced Threat Electronic Warfare Emitter Simulator (ETEWES).

SWEG, which was written in FORTRAN, continued to evolve at ACETEF for a number of years. Meanwhile at BDM, a similar model called CIMUL8/SPECT8 was used to create a C language model called CSWEG, for ACBM work done for STRICOM (then PM TRADE). This model was also called ACBM. CSWEG continued to evolve at BDM, and later at Bosque Technologies, until CSWEG 5.+ was released. Shortly thereafter, the use of the FORTRAN SWEG was terminated by ACETEF, the C version was adopted, and CSWEG 5.+ became SWEG 6.0. The new SWEG was then controlled by ACETEF, with development support from Bosque, until version 6.4.3.12.21. At that point, ACETEF took the development in-house, and subsequently renamed this version 6.5.0. The current SWEG baseline is version 6.5.5. Both Bosque and BDM remain active in SWEG development for external project sponsors, but do not directly support ACETEF.

2.3 VERSION DESCRIPTION AND CURRENT STATUS

Table 2-2 lists the items to be maintained under the CM plan described in Ref. [3], including source code, other files maintained on magnetic media, documentation, test plans and historical information. In the past, SWEG documentation was prepared by Bosque Technologies, Inc., of Albuquerque NM, for ACETEF. Starting with version 6.5.0, ACETEF now maintains the documentation and has been augmenting the Version 6.5.0 User's Manuals with change pages. Configurable items are identified by the model version number; no separate configuration numbering system is employed.

TABLE 2-2. Configurable Items for SWEG Version 6.5.5.

Description	Classification	Date
SWEG Source Code, version 6.5.5	Unclassified	Jan 97
SWEG source code compilation scripts	Unclassified	Jan 97
SWEG Boot files	Unclassified	Jan 97
SWEG Symbol files	Unclassified	Jan 97
SWEG “Random” and “Bigbang” instruction files	Unclassified	Jan 97
SWEG Debug and Test Tools	Unclassified	Jan 97
SWEG User’s Guide, Volume I, Theory and Practice	Unclassified	Sept 96
SWEG User’s Guide, Volume II, Parts 1 and 2, Input Data Item Reference	Unclassified	Feb 96
SWEG User’s Guide, Volume III, Model Response	Unclassified	Feb 96
SWEG User’s Guide, Vol. IV, Interfaces	Unclassified	Sept 96
SWEG Version Control, Packaging, and Release Notes	Unclassified	Jan 97

SWEG User’s Guide, Volume I: Theory and Practice

Volume 1 of the SWEG User’s Manual [4] contains an overview of SWEG. It describes the architecture and concepts underlying SWEG, and explains how to operate SWEG on your computer. This publication also includes guidance for analyzing a problem from a SWEG point of view and for interpreting the results obtained from the model when it is exercised.

SWEG User’s Guide, Volume II: Input Data Item Reference

Volume II [5] contains a complete description of the instructions that can be used to drive SWEG. The instructions are formulated using a special language, the SCL. Because of its large size, Volume II is contained in two books. Book 1 contains Type Data Base instructions. Book 2 includes instructions for the Icon, Scenario, Ground, Environment, Run Time and Analysis Data Bases.

SWEG User’s Guide, Volume III: Model Responses

Volume III [6] describes responses generated by the SWEG code during model execution. The two primary types of responses are incidents and messages. Incidents are the method by which the simulation informs the user about the progress of the exercise. They are the time history data items which are recorded as SWEG executes. Messages inform the user about errors that might have occurred, or information about how the simulation is operating.

SWEG User’s Guide, Volume IV: Interfaces

The Interface Document [7] is the primary documentation for interfacing other simulations and simulators to SWEG. It contains reference information on the SWEG Data Interface System (SWEDAT) as well as example commands for use in ACETEF Integration. It contains descriptions of the input formats for the Configuration Database. This document also describes the data blocks for shared memory.

2.4 CHANGE PROCEDURES

Establishment and enforcement of procedures for the development and distribution of a warfare simulation with DoD-wide use is considered essential to ensure its continued credibility. The guidelines implemented for SWEG, or planned for implementation, are outlined in this section.

ACETEF is the focal point for SWEG planning and development. The SWEG Support Activity being established at ACETEF will be responsible for processing all change requests and for formal configuration and version control of the SWEG simulation, as described in [3].

The SWEG Review Board certifies and approves all major versions of SWEG as ready for distribution. The board submits requirements for SWEG to the Model Manager. Meetings of the SWEG Review Board are led by the SWEG Model Manager. Voting members of the Board include the ACETEF Program Manager, the ACETEF Project Coordination Team Leader, Simulation and Stimulation Division Head, Warfare Simulation Branch Head, the Warfare Simulation Team Lead, the SWEG Model Manager, the ACETEF Deputy for Operation, the ACETEF Deputy for Development, and other members of ACETEF Management.

The Configuration Manager maintains a SWEG Change Request (SCR) Database, tracks the status of SCRs, and provides reports as needed. SWEG Teams are responsible for the development, maintenance and testing of the SWEG software, under the direction of the Model Manager. Figure 2-3 shows the relationships between the various SWEG maintenance and development elements, and Figure 2-4 diagrams the Configuration Management process flow.

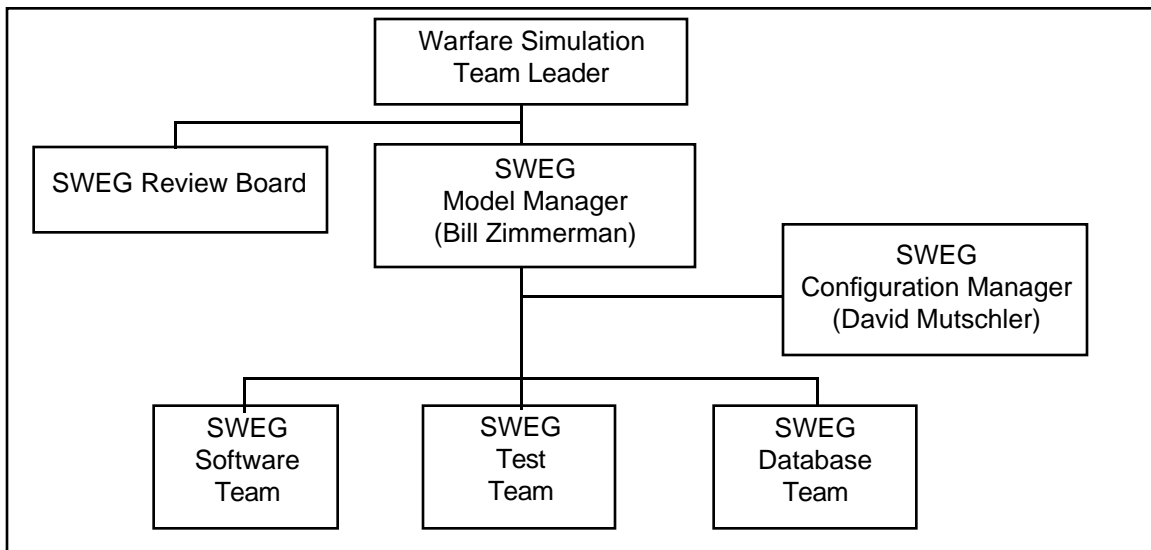


FIGURE 2-3. SWEG Maintenance and Development Elements.

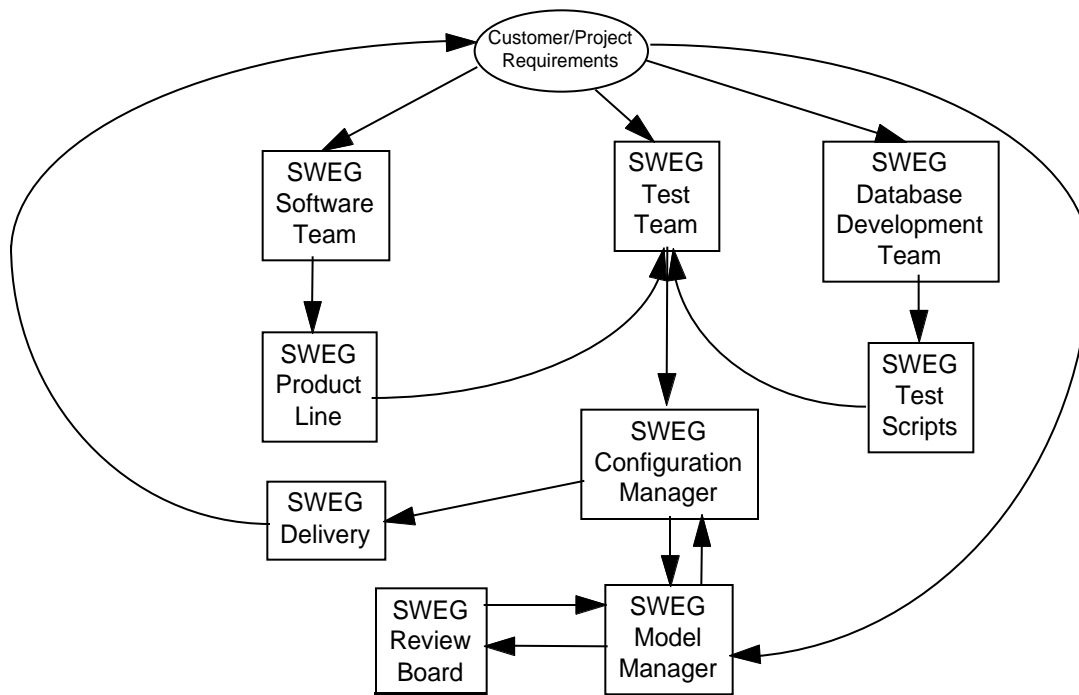


FIGURE 2-4. ACETEF SWEG Development and Configuration Management Process.

SWEG Change Requests

All modifications of the SWEG software are handled through SCRs. An SCR may pertain to an error, deficiency, enhancement, or additional requirement. SCRs may be submitted to the model manager by any individual, including SWEG Team members, as well as users external to ACETEF. Figure 2-5 shows the SWEG Change Request form.

Title: _____

Submitted By: _____ Date Submitted: _____

Project: _____ SCR Project ID No.: _____

SCR Classification

Suspected Bug: _____ Desired Improvement: _____

Requested Priority: _____ (1=critical, 2=major, 3=normal, 4=lowest)

SWEG Version : _____

Platform: _____ Operating System: _____

SWEG Component (indicate all that apply)

ADB: _____ CDB: _____ EDB: _____ GDB: _____ IDB: _____ LDB: _____ RDB: _____ SDB: _____

TDB: _____ Other: _____

Configuration Management: _____ (please specify in description)

Documentation: _____ Specify Document _____

Software Quality: _____ (please specify in description)

SWEG Interface Library: _____ Specify Version Number: _____

Scenario or Test Script: _____ Specify Scenario: _____

Change Request Description (include Justification):

Please be as specific as possible. Use continuation sheets as necessary

FIGURE 2-5. SWEG Change Request Form.

Figure 2-6 illustrates the SCR life cycle. Once acquired, an SCR will be logged by the Configuration Manager in an SCR Database and assigned an initial status of OPEN. The Model Manager then may either assign the SCR to a SWEG Software Team member for correction or may change the status to POSTPONED or DISMISSED. A status of POSTPONED may be assigned if it is determined that action should wait until development of a future major SWEG release. The DISMISSED status is assigned if the request falls outside the effort's scope, is determined to be due to improper execution, duplicates an existing SCR, or otherwise not worthy of attention. When an SCR is reported as corrected by a SWEG Software Team member, it is considered FIXED. Once the correction is verified by the SWEG Test Team, the SCR is CLOSED. An SCR database, containing description and status information on each SCR, is currently implemented in Filemaker Pro and is maintained by the SWEG Configuration manager. The development operating system is employed to maintain a record of changes to the Development version of the software.

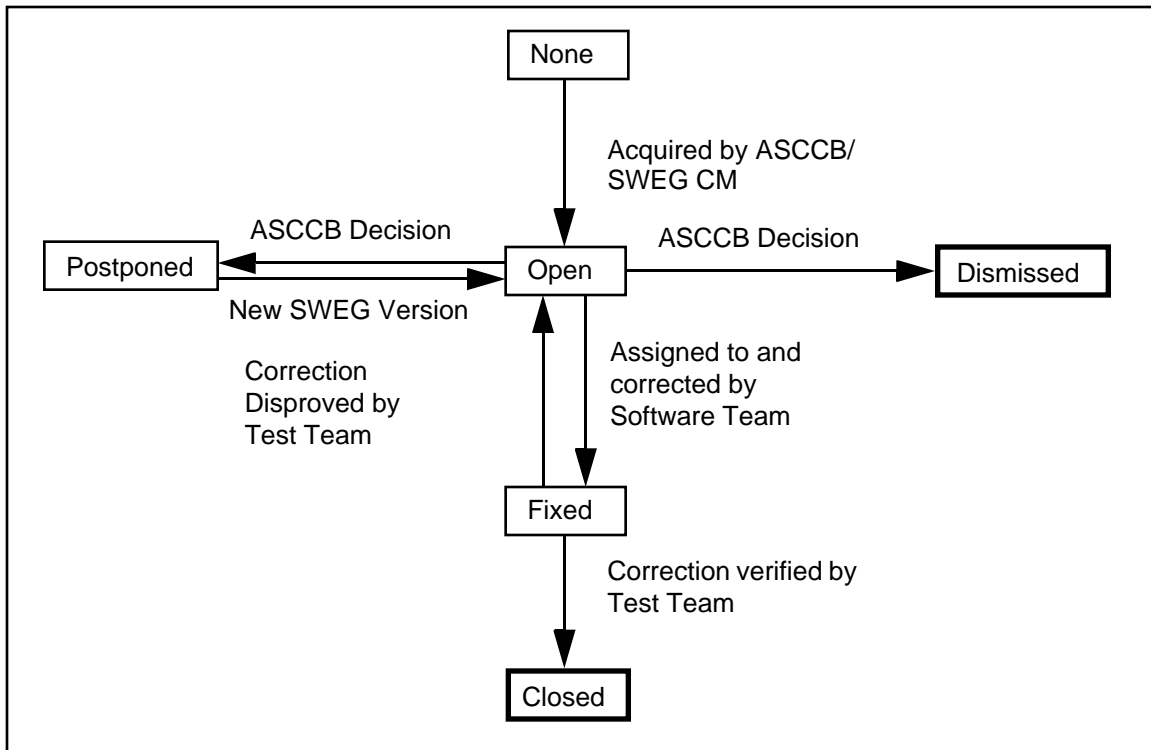


FIGURE 2-6. SWEG SCR Cycle.

All SCRs have an assigned priority based upon the potential effect upon ACETEF customers. Priorities are rated from one (the highest) to four (the lowest).

- Priority 1: This error, deficiency, or lack of capability prevents SWEG from executing a desired mission.
- Priority 2: This error, deficiency, or lack of capability prevents SWEG from executing a major portion of a desired mission. The mission's worth is severely lessened.
- Priority 3: This error, deficiency, or lack of capability prevents SWEG from executing a minor portion of a desired mission. Furthermore, either another method of accomplishing that part of the mission exists or the problem does not severely affect the mission worth.
- Priority 4: This error, deficiency, or lack of capability does not impact the execution of any desired mission. Resolution of the SCR is desired but the lack of resolution does not impact the worth of any mission.

Version Numbers and Release Policy

The Bosque model developer used a five-part version numbering, which was modified for each bug fix made to the code. ACETEF has simplified this numbering system by instituting a three number designator (beginning with the renaming of version 6.4.3.12.21 to 6.5.0) and an optional appendix. The first number indicates compatibility with the SCL and with SWEDAT. Newer versions of the model will be backward compatible with SCL instructions written for previous versions, as well as the SWEDAT interface, as long as the

first number remains the same. The second number will indicate a major revision, and the last number will indicate a patch or minor version. The appendix is used to indicate temporary version of the software -- usually mandated by the immediate need of an ACETEF project. Additionally, a Greek letter may be added to designate internal builds that are not for public distribution. Each new version may include many resolved SCRs.

Major revisions will be released either when driven by ACETEF project requirements or periodically. An annual release cycle is planned. Major versions will include corrections for errors and deficiencies as well as the inclusion of new requirements. All major versions will be tested by the SWEG Test Team and the release will be approved by the SWEG Review Board. When a major version is first released the minor (third) number will be set to zero.

Minor versions will be released to correct priority one or priority two errors and discrepancies. Corrections for less serious errors as well as modifications to satisfy additional requirements are planned to be added to major versions only. Because of the serious nature of the errors corrected, full tests may not be made on minor versions. Instead, only those tests pertinent to the error will be made.

In some cases, it may be expected that a project will modify SWEG outside the official configuration control process. In this case, the appendix or other naming convention should be employed to identify these versions of SWEG. The user agreement requires projects modifying the simulation to submit these modifications to ACETEF for possible integration into the mainstream version of SWEG.

A SWEG Acceptance Test Plan will address the testing of SWEG updates authored by ACETEF or external developers. The plan will include a series of test scenarios, or "vignettes", and is scheduled to be complete in November 1997, for the testing of Version 6.5.6. Currently, additional test vignettes are being developed to address specific capabilities that have been implemented in the development version of 6.5.6.

2.5 USER SUPPORT FUNCTIONS

ACETEF has initiated SWEG User Group meetings, under the direction of the SWEG Model Manager, with organizational assistance provided by the Survivability/Vulnerability Information Analysis Center (SURVIAC). These meetings will be open to the community at large, with the first meeting in September 1997, in Colorado Springs, CO. Additional User Group meetings are currently planned to occur on a semi-annual basis. These meetings will address user needs, concerns, and requirements in an open forum.

BDM International has recently established a User's Group forum using a list server, or "reflector site". All electronic mail sent to the list address will be sent to all SWEG users who are subscribed to the list. The forum does not replace the configuration management process controlled by ACETEF, but this forum can address forthcoming SWEG releases, possible bugs and undocumented features, desired new features, questions about how SWEG works, upcoming training, and other issues of interest to the user community. To subscribe to the list, send an email message to:

Majordomo@bdm.com

with the following line in the body of the message:

subscribe sweg-users-l <your email address>

Note that the “l” after users is an “ell”, not an “eye” or a numeral “1”. To send a message to the site, address it to “sweg-users-l@bdm.com”. (Be sure to use this address whenever you wish to respond to a message received from the site--do not just send a “reply” to the message.) For questions or help concerning the site, the BDM point of contact information is listed in Table 2-3.

ACETEF does not maintain a formal help desk for SWEG: however, the SWEG user community is small, and user help requirements are generally handled through informal conversations among users. The reflector site should assist users with those communications. SURVIAC, also located at Wright Patterson AFB, OH, has recently taken over the task of logging incoming SCRs, and is establishing an e-mail address for that purpose.

BDM is responsible for SWEG training. Training courses are conducted by BDM on an “as needed” basis. Table 2-3 lists point of contact information for SWEG user support.

TABLE 2-3. SWEG User Support Points of Contact.

Organization	Function	Point of Contact
ACETEF, NAWC-AD Patuxent River, MD	Model Manager/User's Group Chair	Bill Zimmerman voice: (301) 342-6839 fax: (301) email: zimmermanwh%am5 @mr.nawcad.navy.mil
	Configuration Manager	David Mutschler voice: (301) 342-6837 fax: (301) 342-6381 email: mutschlerdw%am4 @mr.nawcad.navy.mil
	SWEG Software Support	Michael Chapman voice: (301) 342-6900 fax: (301) 342-6831 email: chapmanm%am7@mr.nawcad.navy.mil
SURVIAC Dayton, OH	Model Management Support (User's Group Support, SCR Logging)	Linda Hamilton (Booz-Allen & Hamilton, Dayton) voice: (937) 431-2746 email: hamilton_linda@bah.com
	SCR Electronic Submission	email: sweg@surviac.flight.wpafb.af.mil
BDM International Albuquerque, NM	Training	Ross Jones voice: (505) 848-5733 email: rjones2@bdm.com
	User's forum server (reflector site)	Todd Gilbert voice: (505) 848-5177 email: tgilbert@bdm.com

Distribution of SWEG outside ACETEF is subject to the approval of the SWEG Review Board. To receive the model, prospective users are required to sign a formal user agreement which stipulates that ACETEF will be provided with a copy of any modifications. Distribution is controlled due to the need to ensure configuration

management and to limit the propagation of unsupported versions of SWEG. Two forms of SWEG distribution exist: User and Full. The User distribution does not contain the source code. It does include all documentation except the design specification, and all unclassified SWEG test scenarios. The Full distribution contains all files in the directory pertaining to the version being distributed, except for classified test scenario files. SWEG distribution does not include databases, which are the responsibility of the user project.

2.6 IMPLICATIONS FOR MODEL USE

The SWEG Management Plan [3] outlines a comprehensive configuration management system. In the past SWEG was used primarily as an ACETEF in-house model, and management has been informal. In response to increased interest by outside users, ACETEF has recently developed a model management plan which treats model development and configuration management more formally. To date the plan has not yet been completely implemented, and it is too early to tell how effective the management plan and its implementation will be.

The plan focuses on ACETEF's management of SWEG, and does not formally provide for user participation on the SWEG Review Board or in testing of development versions of the simulation (alpha and beta testing). This gives ACETEF more control over testing and model development decisions, but does not take advantage of the expertise and varied analysis interests of the expanding user base. In practice, however, user input to development does seem to be occurring. During the September Users' Group meeting, all open SCRs were discussed, and priority inputs from various project - related users were tabulated for input to the formal SWEG Review Board. This process is planned to be a regular part of the Users' Group meeting format.

